Towards a harmonized bionomenclature for life on Earth

Report of the IUBS/IUMS exploratory meeting on harmonization between Codes of Nomenclature held on 16–18 March 1994 at the International Mycological Institute, Egham, Surrey, U.K.

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Foreword

I was very pleased to participate in this important Exploratory Meeting on *Harmonization between the Codes of Biological Nomenclature*. Those working with bionomenclature have to devote time to being lawyers as well as scientists.

Bionomenclature has relevance to two major issues of topical concern: biodiversity and its key relevance to the sustainable use of Earth's resources, the subject of the

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This Report has been published by the International Union of Biological Sciences as Special Issue 30 (1994) of *Biology International*. It appears here in the same form, with only minimal alterations.

Convention on Biological Diversity, and the importance of modern technologies made available to the producers and users of names of organisms. Molecular biological approaches are shedding new light on the extent of the living world and also require a re-thinking of the relationships between many groups of organisms. Furthermore, modern information and communication facilities provide new avenues for research, training and using the resources of biological nomenclature.

The long-term benefit of a satisfactory bionomenclatural framework is not always appreciated, yet it is fundamental to all who work with or utilize the products of the living world. Bionomenclature has to address problems of stability, accessibility, simplicity, and communicability. These matters need to be considered in any outputs for users.

The prospects include a unified Code for the bionomenclature of organisms to operate from a date in the future, and also an increasing harmonization between the existing Codes dealing with the nomenclature of the past. There is also a need to teach the principles and practice of bionomenclature more widely so that biologists will understand what is involved and how the perceived problems are being addressed. This should be an integral part of biodiversity training programmes. The planned publication of an authoritative glossary agreed at the meeting will be especially important in this regard.

I am pleased that this Exploratory Meeting was able to identify steps that can be taken to move these issues forward in a positive way.

On behalf of the International Union of Biological Sciences (IUBS), I would like to express our deep appreciation of the contributions and support provided by the International Union of Microbiological Societies (IUMS), the International Association for Plant Taxonomy (IAPT), the Royal Society of London, and CAB INTERNATIONAL. The Linnean Society of London generously hosted a reception for participants. Finally, I wish to express sincere thanks to Professor David L. Hawksworth, Director, and Ms Marilyn S. Rainbow, both of the International Mycological Institute, for arranging, graciously hosting, and taking all steps to ensure the success of this landmark meeting.

T. Younès
Executive Director, IUBS
Paris, 24 May 1994

Summary

The Exploratory Meeting on Harmonization between Codes of Nomenclature, convened at Egham on 16–18 March 1994 in accordance with a Resolution of the General Assembly of the International Union of Biological Sciences (IUBS), and with the support of the International Union of Microbiological Societies (IUMS), the International Association for Plant Taxonomy (IAPT), the Royal Society of London, and CAB INTERNATIONAL. The following text was agreed by all participants at the concluding session of the Meeting.

The Meeting:

1. *Recognizes* the crucial importance of scientific names of organisms in global communication to all concerned with the conservation, management, trade in, and use of the world's resources.

2. *Agrees* that it would be highly advantageous to work towards a unified system of biological nomenclature, and *notes* that the XVI International Botanical-Congress in Japan in 1993 established a Special Committee on Harmonizing Codes.
3. *Recognizes* that while there are differences in procedures between the current Codes, which could not be reconciled for the nomenclature of the past without an unacceptable disruption of names in use, there is considerable scope for harmonization which is to be actively pursued.
4. *Considers* that the availability of lists of published names, and the registration of new names in bacteriology, botany, virology and zoology, will make possible the harmonization of nomenclatural procedures in biology.
5. *Agrees* to work towards producing a *Glossary of Biological Nomenclature*, including both official and unofficial terms.
6. *Recommends* that, considering divergent rules and traditions concerning author citations for scientific names, use of such citations be made optional (and be recommended only in a strictly taxonomic context), as is already the case in zoology.
7. *Recognizes* the need to develop common procedures for the nomenclatural treatment of fossils, with particular emphasis on form genera and other parataxa, and to this end *recommends* IUBS in cooperation with international and national bodies such as the Systematics Association and the Palaeontological Association, to organize a discussion meeting on this topic.
8. *Agrees* that the nomenclature of infraspecific taxa in ranks not regulated by the three main Codes is most appropriately regulated by international specialist commissions or groups (e.g. International Society for Plant Pathology Subcommitee on the Taxonomy of Phytopathogenic Bacteria for pathovars of bacteria, International Commission for the Nomenclature of Cultivated Plants for cultivars of plants).
9. *Encourages* international, national, and other agencies to initiate and support current initiatives in compiling lists of names in current use and other catalogues of names, to be made accessible through hard copy and electronic media.
10. *Notes* the rapid advances in electronic media for the storage of and access to taxonomic information, and the opportunities they provide in relation to inventorying the world's currently known and unknown biota, and *encourages* the IUBS Commission on Taxonomic Databases, in collaboration with the Special Committee on Electronic Publishing and Databasing, to prepare proposals for consideration by the pertinent nomenclatural committees.
11. *Recognizes* the particular nomenclatural problems posed by ambiregnal organisms, that is those treated under different Codes, *considers* that small modifications to the Codes can accommodate these organisms to ensure that the names used will be unique, and *recommends* that while discussions continue authors should avoid exacerbating the problems.
12. *Appreciates* the confusion that can be caused by the existence of homonyms in use under the different Codes, and *recommends* that (a) authors of new generic names avoid proposing a name established under another Code for a

different taxon, and (b) provisions are introduced into each Code to disallow new generic names that are junior homonyms under any Code.

13. *Recognizes* the importance of continuing the dialogue started at, and implementing actions identified by, the Exploratory Meeting, *recommends* that an inter-union IUBS/IUMS International Commission on Bionomenclature (ICB) be established in 1994, and *suggests* that the new Commission includes a delegate representing each of the current five Codes, together with representatives from key user bodies (e.g. FAO, UNEP, IUCN, UNESCO, WHO).
14. *Recommends* that the organizers of the Fifth International Congress of Systematic and Evolutionary Biology (ICSEB V), to be held in Budapest in 1996, include a session to review progress towards harmonization and other aspects of bionomenclature.

1. Background

The name by which an organism is known is vital for two reasons: it is the key to all the accumulated human knowledge about its characters, utility, ecology, biology, and history, and also the medium by which communication between all biologists is effected. The issues relating to the naming of organisms are therefore high on the agenda of the two major international unions representing the biologists of the world, the International Union of Biological Sciences (IUBS) and the International Union of Microbiological Societies (IUMS).

With world attention focussed on biological diversity, and the realization that perhaps 10% or less of the Earth's biota has so far been named (Hammond, 1992; Systematics Agenda 2000, 1994), the need to maximize the effectiveness of the system of naming organisms of all groups has never been greater.

The process by which names for all living and fossil organisms that inhabit Earth have universally accepted forms is currently regulated by five internationally mandated bodies operating under the aegis of either IUBS or IUMS and each issuing a periodically revised series of rules or a Code of nomenclatural practices. These bodies are the:

General Committee on Botanical Nomenclature (GC),
International Commission for the Nomenclature of Cultivated Plants (ICNCP),
International Committee on Systematic Bacteriology (ICSB),
International Commission on Zoological Nomenclature (ICZN),
International Committee on Taxonomy of Viruses (ICTV).

Each of these bodies has a unique history and tradition, but increasingly they have issues in common to confront, not only in meeting the demands resulting from issues arising from the biodiversity lobby, but further in relation to the scientific re-evaluation and classification of phyla between kingdoms, the challenges posed by molecular approaches, and the new horizons opened up by innovations in electronic communications and data processing.

IUBS has been aware for some time of the need to keep the systems of biological nomenclature under review, and on the occasion of the Third International Congress of Systematic and Evolutionary Biology (ICSEB III) in Brighton, U.K., in July 1985 it convened a workshop 'to study future developments of the various Codes of nomenclature' following a session organized by the Systematics Association on 'Codes of Nomenclature' (Ride & Younès, 1986).

Recognizing that name changes for non-scientific reasons continue to inconvenience all users of the scientific names of organisms, IUBS, in collaboration with the International Association for Plant Taxonomy (IAPT) and the Systematics Association, organized the first major international meeting convened specifically to address the stability of names. This meeting, 'Improving the Stability of Names: Needs and Options' was held in Kew on 20–22 February 1991, and attracted 123 participants from 20 countries (Hawksworth, 1991).

It became clear at the Kew meeting that there were more common issues to confront than had widely been appreciated, and the matter was considered further at the 24th General Assembly of IUBS held in Amsterdam on 1–6 September 1991 (Younès, 1992). That Assembly passed a Resolution on Biological Nomenclature which, amongst other things:

> '*ENCOURAGES those concerned with biological nomenclature actively to seek ways of increasing harmonization in the various Codes, for example, with regard to the protection of names in current use, the registration of newly proposed names, the treatment of protists, homonymy between different groups, and where possible, the use of identical terms.*'

As a first step in the implementation of this Resolution, an Exploratory Meeting on 'Harmonization between Codes of Nomenclature', comprising official representatives of the five different Codes together with selected other biologists with particular experience on specific topics to be considered, was convened at the International Mycological Institute (an Institute of CAB INTERNATIONAL) in Egham on 16–18 March 1994 under the joint auspices of IUBS, IUMS, and the International Association for Plant Taxonomy (IAPT), together with support from CAB INTERNATIONAL, the Linnean Society of London, and the Royal Society of London. We believe that the strength of this support, together with the high level of representation fielded by the current nomenclatural bodies, reflects the current desire to place the nomenclature of living organisms on as secure a basis as practicable with the advancement of science.

This Meeting was scheduled for March 1994 as at that time: (1) the editing of the text of the 1994 Tokyo edition of the International Code of Botanical Nomenclature was largely complete; (2) the discussion draft of the new edition of the International Code of Zoological Nomenclature was undergoing finalization by the ICZN prior to wide distribution for comment; (3) the ICSB would meet during the IUMS Bacteriology Division Congress in Prague in July 1994; (4) a new edition of the International Code of Nomenclature for Cultivated Plants was being actively planned; (5) the ICTV had adopted new procedures for the treatment of names of viruses at the IUMS Virology Division Congress in Glasgow in August 1993; and (6) a report with any recommended actions could then be presented to the 25th General Assembly of IUBS in Paris on 5–9 September 1994.

Prior to the start of the Exploratory Meeting, and in order to ensure that issues of concern were not overlooked, each of the nominated representatives of the different Codes was invited to submit both topics for discussion and background papers for circulation to other participants in advance of the occasion.

This report of the discussions and agreed Executive Summary of the Exploratory Meeting is presented here to open up and stimulate new debate on the issues identified, without prejudice to any future decisions, and so to expedite progress towards increased harmonization between the various international bodies involved. Indeed, it is essential that the widest possible spectrum of biosystematists and other users of names contribute to the resolution of the issues raised. This is necessary to ensure that any changes in operating procedures are based on the broadest possible constituency of biologists.

2. The Current State of Bionomenclature

(a) The Current Status of the Codes

The current (third) edition of the Zoological Code is that of 1985 (International Commission on Zoological Nomenclature, 1985). The ICZN is working towards a fourth edition; the Editorial Committee met in Hamburg in October 1993. Under the Constitution of the ICZN, a discussion draft has to be available to the zoological community for comment for one year. The draft is expected later in 1994 and it is anticipated that the new Code will be published in 1996 and become operational in 1997. A major change in emphasis in the draft is to attach somewhat more attention to usage than to priority of publication.

The editing of the text of the Tokyo edition of the Botanical Code, revised in accordance with decisions at the XV International Botanical Congress held in Yokohama in August-September 1993, was now almost complete and publication in June 1994 was anticipated (Greuter *et al.*, 1994a). This edition differs significantly from the previous edition published in 1988, many of the changes representing a convergence with, rather than a divergence from, other Codes.

The ICNCP is moving towards a total revision of the Cultivated Plant Code (Brickell *et al.*, 1980), which it is planned to finalize after a symposium being convened in Seattle by the Commission in August 1994. The new edition was expected in 1995, and there was a desire to ensure that this was fully compatible with the Botanical Code.

The Bacteriological Code was revised completely in the mid-1970s and is working well with the new starting-point date of 1980. Changes since the 1976 edition have been minor, the latest revision being issued in 1992 (Sneath, 1992). Infraspecific plant pathogenic bacteria are considered by the International Society for Plant Pathology (ISPP) Subcommittee on Taxonomy of Phytopathogenic Bacteria, which has issued lists of approved pathovar names and minimum standards for their naming; the most recent available list was published in 1991 (Young *et al.*, 1991) and a revision is planned for late 1994.

In the case of the viruses, there are Rules and Guidelines (Francki *et al.*, 1990) rather than a formal Code, virologists working by good-will rather than regulation. It has, however, been suggested that these are tightened and transformed into a Code. At the Virology Congress in 1993 various changes were made.

There has been some discussion as to the merits or otherwise of a separate Code for protoctistan (protist) groups (Corliss, 1993), but workers in the field were now focussing their attention on bringing about changes in the current Codes to cater for the difficulties they were experiencing.

(b) The Decision Making Processes

Decision making under the Botanical Code falls into two main domains: those concerning rules and those concerning individual names. Everything relating to the rules has to be dealt with by the Nomenclature Section of an International Botanical Congress, and there are no restrictions on those who can register for the Congress and thereby participate in the Section meetings. Before the Congress, proposals normally have to be published in the IAPT's journal *Taxon*; a synopsis of the proposals is then presented with comments by two rapporteurs. An exploratory mail ballot of IAPT personal members is held, and the results are made available to the members of the Nomenclature Section. The proposals are debated and voted at the Section meeting; transcripts of these discussions are edited and published (e.g. Greuter *et al.*, 1994b). Section actions are then ratified by means of a formal Resolution passed at the final plenary session of the Congress, normally a formality. There are six group-orientated Permanent Committees that work between Congresses, whose main task is to consider proposals to conserve or reject names, which also have to be published in *Taxon*, and also Special Committees established by the Section to examine particular issues and normally instructed to report to the next Congress. The Permanent Committees report through a General Committee (GC) which has responsibility for botanical nomenclature between Congresses. Reports of the various Committees are published in *Taxon*. The operation of botanical nomenclature is described in detail by McNeill & Greuter (1986).

The International Commission for the Nomenclature of Cultivated Plants (ICNCP) meets largely as determined by the Chair when a revision of the Code is considered to be opportune. There is no democratic process, the Chair inviting persons from different applied disciplines to a meeting convened at an appropriate occasion, for example the International Symposium on the Taxonomy of Cultivated Plants being held in Seattle in 1994. The Chair is appointed by IUBS. The Commission then works on the Code and arranges for its publication. There is a move to increase democratic participation and this will be discussed at the Seattle Symposium. There is no official journal in which proposed changes can be published.

The procedures in zoology were originally on lines similar to those for the Botanical Code, but have been modified since the last International Congress of Zoology was held in Monaco in 1972. The present position is that under the Constitution of the International Commission on Zoological Nomenclature (ICZN), amendments to the Zoological Code have to be published for one year prior to final approval. The discussion draft of the forthcoming edition for the Code is being made widely available at nominal or no cost. Comments received on the draft are considered first by the Editorial Committee and then by the Commission. The final version is decided by the voting of the ICZN, which has members from 19 countries, and has to be ratified by IUBS, the body under whose auspices the Commission operates.

Decisions on *ad hoc* issues in zoology, notably those relating to names or published works, are taken by the ICZN. The Commission has plenary power to set aside any provision of the Code whenever that is judged to be in the best interests of stability. Proposals have to be published for at least six months in the *Bulletin of Zoological Nomenclature*, and in addition notices of proposed actions are sent to journals relevant to the group concerned. Comments received are also published in the *Bulletin*, and, when the flow of these has ceased, voting papers are sent to the members of the ICZN. A two-thirds majority is needed to approve the use of the plenary power.

The ICZN meets at IUBS General Assemblies and ICSEB, and can be convened at other congresses. All Committees of the ICZN are established by its President.

The International Committee on Systematic Bacteriology (ICSB) is part of IUMS and comprises members elected by societies that are affiliated to IUMS, each of which can propose 1–3 members for each nation. Members serve while the nominating societies wish them to continue so to do, and the ICSB can also co-opt others when necessary. There is an elected Judicial Commission of about twelve members plus the officers *ex officio*; currently 17 in total. The Commission takes decisions but these have to approved by the ICSB and the IUMS Bacteriology Division Congress. Code changes are made by the Judicial Commission following publication a year in advance, but it has wide powers with respect to wording in particular. *Ad hoc* decisions on particular cases are taken by a two-thirds majority on the basis of requests published in the *International Journal of Systematic Bacteriology* (IJSB), published, and finally ratified by the next Congress.

The ICSB appoints Subcommittees which are responsible for the taxonomy of a specified group of organisms. These are not regulated in number or size, and can be created or dissolved according to need; there are currently about 30. A key role for the Subcommittees is the establishment of minimal standards for the description of taxa in those groups; these now exist for six groups. The Subcommittees report by minutes published in the IJSB, and deal with taxonomic and methodological developments.

Virus nomenclature is controlled by the International Committee on the Taxonomy of Viruses (ICTV), a committee of the Virology Division of IUMS. The ICTV consists of an Executive Committee and national representatives, and a new Executive is formed at each Virology Congress. The Executive Committee consists of individual members and the chairs of subcommittees responsible for different areas of virology. The President decides which subcommittees are required, the Executive votes for chairs of those, and the subcommittee chairs select their own members and establish Study Groups. The Study Groups bring taxonomic and nomenclatural proposals to the subcommittee and thence to the Executive. The Executive then votes on acceptability, and the ICTV Plenary Session at each Congress votes formally on any changes in the rules. Proposed changes *may* be aired in the Virology Division News section of the *Archives of Virology* or in any conventional publication. The 'News' also publishes minutes of ICTV plenary sessions. The rules for viruses are evolving rapidly at present; the present emphasis is on taxonomic structures. Species are examined at the Study Group level, and if accepted are included in the ICTV Report published after each Congress that is a complete taxonomic description of virus taxa.

(c) Nomenclatural Filters

The steps through which names are sieved in the process of determining the correct nomenclature of a taxon can be viewed as a nomenclatural filter. This diagrammatic approach, first used by Jeffrey (1973), was felt to be helpful to users of the Codes both as a flow chart and to identify cases where terms were used in similar senses. The various steps, and the terminology of those steps, are summarized in Figure 1, indicating equivalent terms where appropriate (see also Table 1).

The 'Nomenclatural Filter'

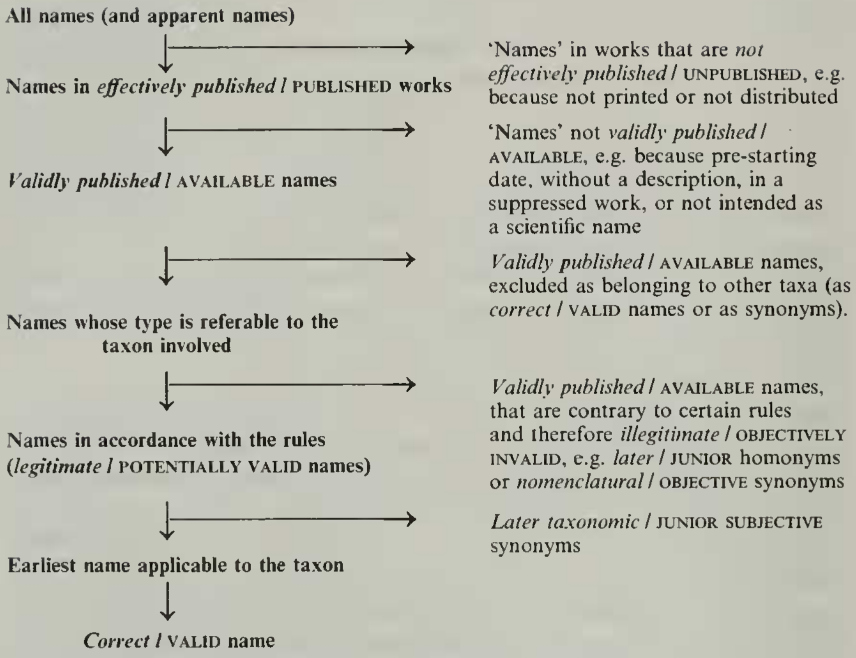
All names (and apparent names)
Names in *effectively published* / PUBLISHED works
'Names' in works that are *not effectively published* / UNPUBLISHED, e.g. because not printed or not distributed
Validly published / AVAILABLE names
'Names' not *validly published* / AVAILABLE, e.g. because pre-starting date, without a description, in a suppressed work, or not intended as a scientific name
Validly published / AVAILABLE names, excluded as belonging to other taxa (as *correct* / VALID names or as synonyms).
Names whose type is referable to the taxon involved
Validly published / AVAILABLE names, that are contrary to certain rules and therefore *illegitimate* / OBJECTIVELY INVALID, e.g. *later* / JUNIOR homonyms or *nomenclatural* / OBJECTIVE synonyms
Names in accordance with the rules (*legitimate* / POTENTIALLY VALID names)
Later taxonomic / JUNIOR SUBJECTIVE synonyms
Earliest name applicable to the taxon
Correct / VALID name

Fig. 1. *The Nomenclatural Filter.* The steps to be taken in determining the name of an organism appear in the left-hand column. *Italic* type signifies terms used in the Botanical Code; SMALL CAPITAL type the equivalent terms in the Zoological Code (see also Table 1).

Further information on terms and their definition discussed during the Meeting is being incorporated into a Glossary.

3. Issues to be Addressed

(a) Harmonization of Terms

Identical words are used in different ways or for different concepts in the various Codes. This is a potential source of ambiguity, but most of the differences are not in kind but rather in terminology.

As a component of the Biotaxonomy and Nomenclature Programme of IUBS, its 24th General Assembly saw 'advantage in the preparation of a comprehensive Glossary of Biological Nomenclature covering officially recognized and also unofficial terms used throughout biological nomenclature' (Younès, 1992). A rough draft compilation of both official and unofficial terms used in biological nomenclature had been compiled as part of the background material for the Meeting for discussion as how best to fulfil the IUBS suggestion.

The equivalence in meaning of some of the different 'official' terms was discussed, and the more widely used of these are arranged as equivalents in Table 1.

Table 1. *Botanical and Zoological equivalent terms*

Botanical Code	**Zoological Code**
Effective publication	Publication
Effectively published	Published
Not effectively published	Unpublished
Validity	Availability
Valid/Validly published	Available
Invalid	Unavailable
Legitimacy	[———]
Legitimate	Potentially valid
Illegitimate	Objectively invalid
Correctness	Validity
Correct	Valid
Incorrect	Subjectively invalid
Homonymy & synonymy	Homonymy & synonymy
Earlier homonym/synonym	Senior homonym/synonym
Later homonym/synonym	Junior homonym/synonym
Nomenclatural synonym	Objective synonym
Taxonomic synonym	Subjective synonym

It was felt that a *Glossary* that could be used in common by all Codes would go a long way towards harmonization, and that it should be designed so as to give guidance as to what terms should be used, perhaps with comparative tables of equivalents. Examples could be particularly helpful for students. Such a glossary would need to be widely available, and this could perhaps be achieved by simultaneous publication in three or more outlets familiar to different disciplines.

The General Committee on Botanical Nomenclature was independently mandated by the XV IBC in 1993 to produce a glossary of terms used in botanical nomenclature. The botanical entries could perhaps be taken as fulfilling that mandate if this were made open as a draft for comment by all botanists. In zoology, the glossary is part of the Code, but in principle harmonized terms and definitions could be taken into the forthcoming fourth edition during its consultative phase. Bacteriology could potentially take on some terms from other areas and use them in common.

Because this work needs to proceed with care, as a second stage it was considered appropriate to produce a *Draft Glossary of Bionomenclature* for wide distribution as a working document for refinement. A third stage would be the release of a Glossary with at least the approval of the appropriately mandated nomenclatural bodies. An optional fourth stage would be recognition as official definitions by, for example, the XVI International Botanical Congress in 1999. Terms could then be 'plucked-out' and included in individual Code glossaries.

In order to reach the second stage participants agreed to supply comments on the tabled rough draft for incorporation prior to the wider circulation of the *Draft Glossary*.

The Meeting agrees to work towards producing a Glossary of Biological Nomenclature, including both official and unofficial terms used in biological nomenclature.

(b) Suprafamilial Ranks

While the long-standing issue of the acceptability of the term 'phylum' as an alternative to 'division' had now been approved at the XV International Botanical Congress in 1993, as a result of molecular studies there was currently a tendency to introduce names at ranks higher than that of kingdom, for example 'domains', 'empires', and 'superkingdoms'. The Botanical Code specifies the order and names to be used for all ranks, although it dos not legislate priority above the rank of family. In contrast, the Zoological Code does not concern itself in any way with ranks above that of superfamily.

As the number of names for suprafamilial ranks is relatively small, this issue was perhaps best left to specialists or specialist committees and not regulated further. Usage was an especially important consideration as changes in very high groupings would not be readily accepted by users and would tend to bring efforts to standardize nomenclature into disrepute.

No advantage in further regulation was felt to be desirable, and advantage was seen in using descriptive names rather than ones based on an included genus. The use of standardized endings for particular ranks above kingdom would be desirable when a particular practice had come into general use. Nomenclature should not attempt to interfere with taxonomy.

There could, however, be an advantage in specifying in the *Glossary* the generally used hierarchy of the terms for ranks above kingdom.

The Botanical Code uses standardized endings for taxa above that of family and up to phylum, and the Bacteriological Code employs those same terminations up to and including order. However, this is not so in zoology, and the zoological practice could lead to other difficulties (see below).

(c) Co-ordinate Status of Names

In the Zoological Code, names are arranged in categories: species-group, genus-group, and family-group names. Names may change in rank within those groups, for example species to subspecies, but the author citations and dates remain the same. Name changes are limited to the suffix of family-group names. This is a very flexible principle limiting name changes with change of rank, but tending to foster them with changes in generic limits because subspecies names can compete with those at species level. The principle works very well, but is unique to that Code. Indeed this is perhaps *the* main difference from the Bacteriological and Botanical Codes in which a name only has priority within its rank, rather than within a group of ranks.

While aspects of the concept had been considered for possible adoption in the Botanical Code in the past (e.g. Weresub, 1979), it merits more critical evaluation. The principle could be acceptable in both bacteriology and botany if it operated only downwards and not in both directions; i.e. the name of a species would automatically be usable at subspecies rank, but not *vice versa*. To do otherwise would be unacceptably destabilizing as numerous well-established names in the principal ranks would otherwise be threatened. Downward coordination would have been an elegant solution to the treatment of autonyms in the Botanical Code as revised at the XIII

International Botanical Congress in Sydney in 1981. If such a proposal were linked with the adoption of a single infraspecific rank in botany (see below), that could facilitate its acceptance.

In some cases in zoology, limiting the principle to downward applications could be less disruptive than maintaining the *status quo*, although the ICZN has the mechanism to deal with cases of particular difficulty. It was noted that the Botanical Code, as revised at the Tokyo Congress in 1993, now also had mechanisms for the rejection and conservation of names in most ranks (Greuter & Nicolson, 1993; Hawksworth, 1993; Nicolson & Greuter, 1994).

A further aspect to co-ordinate status was that in Botany the same epithet can be used for names at different ranks within the same genus when the taxa involved are based on different types, whereas this is not permissible in the Zoological Code.

Proposals to bring downward co-ordinate status into the Bacteriological and Botanical Codes should be explored for discussion by the International Committee on Systematic Bacteriology and at the next International Botanical Congress respectively. Particular attention would need to be given to effects on nomenclatural stability should downward co-ordination operate retroactively, but this was unlikely to cause major disruptions.

A linked but separate issue is that in the Zoological Code an epithet has priority regardless of the genus in which it is placed. For example, if a species is moved into a genus in which the same epithet is already in use for a taxon with a different type, that just transferred is retained if it was published earlier than the epithet already existing in the genus; the latter epithet is then treated as a 'junior secondary homonym'. The opposite situation occurs under the Botanical Code where it is the whole combination, and not just the epithet, that is critical for determining the priority of homonyms. Consequently, in botany, only the taxon whose taxonomic position is being altered is at risk of a change in epithet.

An example of this would be the case of two imaginary species first described as *Antonia barbara* Smith 1900 and *Claudia barbara* Larousse 1850. If Freunde placed these taxa in the genus *Gemma* in 1960 and 1975 respectively, a situation of homonymy would have arisen in 1975. Under the Botanical Code the existing combination *Gemma barbara* (Smith 1900) Freunde 1960 would remain correct, and Larousse's epithet *barbara* of 1850 would have to be replaced. In zoology, however, the older epithet of Larousse would maintain its priority; *Gemma barbara* (Larousse 1850) would be a correct name and the species denoted by the junior epithet *barbara* Smith 1900 would have to be renamed.

(d) Infraspecific Ranks

In practice there is often inconsistency in the use of the terms 'subspecies' and 'variety' in botany, the two being used interchangeably according to different schools, while other authors recognize broadly geographical subspecies and locally or regionally distributed varieties. The Botanical Code currently recognizes five such ranks, while the Bacteriological and Zoological Codes only have that of subspecies. In zoology any name published as a 'variety' or 'form' before 1961 can in principle be treated as a name in the species-group; any published after that date are ruled as unavailable (i.e. not validly published). The Bacteriological Code, because the situation was so tangled, decided not to regulate names below the rank of subspecies, and recognizes only 'subgenus' as a subdivision of a genus. However, bacteriologists were now questioning whether the retention of the ranks of subgenus and subspecies was worthwhile.

It was also a matter of convenience when to regulate and when not to. Regulation should focus on the ranks most crucial for communication.

The ranks of 'variety' and 'form' were viewed as somewhat outmoded. They were used principally at a time when the biological status of populations was not understood, but 'variety' had often persisted in botany for what might be better regarded as subspecies. However, as the names of many infraspecific botanical taxa had never been catalogued or typified, the abandoning of the regulation of names below that of subspecies could help limit nomenclatural changes arising from such names. The Bacteriological Code recommends the avoidance of 'variety', and regards it as identical to 'subspecies' for nomenclatural purposes.

While it was recognized that some workers, especially with plants, still utilized the rank of 'form', the need to regulate this in any way was questionable and certainly priority might be made non-obligatory at that rank.

It was also important to stress, as highlighted by Meregalli (1993), that the terms subspecies and variety should not be used for what are really 'cultivars'. The Cultivated Plant Code seemed to be catering for user needs, although the desirability of bringing it as close as possible to the Botanical Code was recognized. Consideration might be given to the possibility of the Cultivated Plant Code also covering cultivated variants of mushrooms and other fungal strains developed by humans. Parallel problems occur with domesticated animals, but there is no formal regulation and the Zoological Code specifies that it covers taxa that are 'known to exist in nature'; this issue, and also that of hybrids, are aspects of the Zoological Code that merit further exploration.

There seemed to be no sound reason for changing the procedures used for the regulation of pathovar names of plant pathogenic bacteria. The current system was a compromise which appeared to be working well (Young *et al.*, 1991). Plant pathologists have a need for a system of infraspecific names for taxa important as agents of plant disease. The Bacteriological Code also recognizes the terms biovar, chemovar, cultivar, morphovar, phagiovar, and serovar; there is no priority or restriction on the kinds of names used. If there is confusion, a specialist group such as that in existence for the plant pathogenic bacteria can resolve the situation amongst themselves.

In the case of viruses, the current rules specify that infraspecific nomenclature is the responsibility of specialist groups, and also specifically exclude laboratory constructed hybrids and engineered organisms. The Bacteriological Code does not mention hybrids nor other genetically manipulated organisms, and its standing on this issue could be clarified to state that they are best regulated by specialist groups.

The Meeting agrees that the nomenclature of infraspecific taxa in ranks not regulated by the three main Codes is most appropriately regulated by international specialist commissions or groups (e.g. International Society for Plant Pathology Subcommitee on the Taxonomy of Phytopathogenic Bacteria for pathovars of bacteria, International Commission for the Nomenclature of Cultivated Plants for cultivars of plants).

(e) Italicization of Scientific Names

The Editorial Committee for the Tokyo edition of the International Code of Botanical Nomenclature decided, for the purposes of consistency, to print scientific names in all ranks covered by the Code in italic type in the Code itself. This practice is already the norm in some leading botanical journals (e.g. *Plant Systematics and Evolution*), and will now be followed in *Taxon* and perhaps in other botanical journals.

The Bacteriological Code states that all scientific names regulated by it are to be distinguished in a different type face, such as italic. The Zoological Code recommends that for genus- and species-group names a type face be used which is different from the rest of the text. The Zoological Code makes no recommendation for names of families and higher ranks.

The adoption of different type faces makes it clear at a glance whether a higher taxon name was being regulated by a Code and used in a formal scientific or a colloquial sense, for example *Bryophyta* / bryophytes, *Fungi* / fungi, *Ascomycetes* / ascomycetes. The problem is especially acute in English where the vernacular language designations for higher units are often identical to the scientific ones.

The use of italics for all scientific names in zoology could cause difficulties because some higher taxon names would look like genus-group names if they were italicized. Some generic names could easily be mistaken for the names of superfamilies or orders. For example, the butterfly generic name *Ornithoptera* Boisduval 1832 could be an insect order name, and the gastropod generic name *Nuculoidea* Williams & Breger 1916 has the form of a superfamily name. While the use of standardized terminations obviates this risk in botany, this is not the case in zoology where not all terminations are standardized. However, the italicization of names above the rank of genus is not precluded by the Zoological Code.

The matter was viewed as essentially one of editorial standards and practices. Indeed, the Editorial Committee of the Botanical Code did not make this issue a recommendation. The Exploratory Meeting saw advantages in using separate type-faces for all scientific names as standard practice across biology, and the zoologists present suggested the use of small capitals as was already the practice of the ICZN for family-group names in its official publications. There could be flexibility, for example using all italics in publications dealing only with bacteria and botanical groups, but small capitals for names above the rank of genus in zoological publications or ones including zoological as well as other taxa.

(f) Author Citations

In zoology, authors transferring an epithet to a different genus or to a different rank are not usually cited; after transfer the name of the original author of the epithet is simply placed in parenthesis. In contrast, in botany the name of the author combining the epithet into a different position or rank is retained. The basis of this difference in practice relates in part to the issue of co-ordinate status (see above); in zoology priority dates from the original author and is unchanged regardless of alterations in rank or combination, whereas in botanical groups the date of the transfer is critical as it is the whole combination and not just the original epithet that determines priority. In botany priority is important for the purposes of homonymy, which operates for the whole combination, and synonymy, which operates within a rank.

While it was recognized that such basic principles could not easily be reconciled for the past, this was not necessarily so for the future, especially if there were protected lists of some kind. It would be important to evaluate any loss of information in order to decide which is the most preferable course to adopt from a date in the future.

When it comes to citing authors, the current recommendation in the Botanical Code is either to give names in full or to abbreviate them according to a standard system. Attention was drawn to the compilation of almost 30 000 names of authors of scientific names across all botanical groups, together with recommended abbreviations, that has recently been prepared (Brummitt & Powell, 1992).

In bacteriology and zoology, there is no mandatory recommendation on the provision of author citations, the practice being to omit citations for familiar taxa.

Whether authors' names should be cited or not was seen partly as an educational matter. They are now the fashion for botanical names in biological literature generally and not only for taxonomic publications. This involves considerable cost and also time if verification is carefully conducted. In many instances it is superfluous, for example in labelling in botanical gardens, and is often misleading where author names are added uncritically without direct reference to the original source of the name. It should be made clear from some point in the future that these are devices for nomenclaturally interested taxonomists that are only of benefit to a wide user community when applied critically.

It was noted that in some journals the editorial practice is to require author citations only for scientific names *not* in a specified checklist. In non-taxonomic works, the general view of the Meeting was that it was preferable for authors to be encouraged to indicate the checklist, flora, fauna, etc., or other basis of the identifications and names used. This was considered to be of more value than adding citations uncritically from unspecified sources.

The Meeting recommends that, considering divergent rules and traditions concerning author citations for scientific names, use of such citations be made optional (and be recommended only in a strictly taxonomic context), as is already the case in zoology.

(g) Lists of Protected Names

Four lists of names in current use for which protected nomenclatural status was being sought had been generated under a scheme proposed in botanical nomenclature (Greuter *et al.*, 1993a, b, c; Jarvis *et al.*, 1993), but not yet authorized by an International Botanical Congress; in 1993 the scheme achieved 55% of the votes rather than the 60% required for adoption. However, the continuation of exploration of that avenue towards increased nomenclatural stability was authorized at the Tokyo Congress. This meant that there were six years in which to refine those lists so that the issue could be reconsidered by the XVI International Botanical Congress at St Louis in 1999. It was envisaged that such lists would become an integral part of the nomenclatural system for botanical groups by a modest change in the Code that would provide for the protection of lists names on a family or ordinal basis when they become sufficiently authoritative.

In addition, the Botanical Code has two other methods of protection: 'sanctioning', introduced in 1981 to prevent earlier names of fungi which had not been adopted in what had formerly been starting-point books from being taken up

(Korf, 1983); and 'conservation and rejection' of names, which can overrule sanctioned names, and was opened up to names in all major ranks at the Tokyo Congress.

The protection of Names in Current Use (NCUs) was seen as more efficient than conservation as it would give them protection against other unlisted names (not only specified ones, as in normal conservation procedures), and the date, typification, gender, and orthography would also be fixed.

In zoology, 'Official Lists and Indexes' of names and of works already exist. The practice has been to deal only with names where a problem existed, and the Commission then makes a decision as to which name should be placed on the Official List. Major catalogues of names were also available, for example Sherborn's *Index Animalium* (Sherborn, 1902–33), the *Nomenclator Zoologicus* (Neave *et al.*, 1939–1993), and the *Zoological Record.* A list of the approximately 400 000 generic names ever used in zoology is currently in preparation; it is planned to have this available on CD-ROM in the near future. That generic list will have no official nomenclatural status, and so will be equivalent to the *Index Nominum Genericorum* (*Plantarum*) (Farr *et al.*, 1979).

However, the discussion draft of the next edition of the Zoological Code would include enabling legislation so that, on the initiative of a group of zoologists interested in a particular field, the ICZN will be able to 'protect' a list of names with dates and types. Such a list would have a closing date, and no relevant name published before that date would have any nomenclatural status unless it were recorded on the list.

There were major differences in scale between the different groups due to the number of names to be handled, but it was accepted that even within speciose groups certain families or orders were relatively well-known and some protection could be considered. The experience of the bacteriologists was pertinent; the Gordian Knot was cut by producing a list of names, publishing it as a draft, and opening it up for addition by other bacteriologists, particularly through subcommittees concerned with particular groups. The *List of Approved Names* (Skerman *et al.*, 1989) for bacteria was a new starting-document for the group, and includes about 2330 names in all; 130 suprageneric names, 300 generic names, and 1900 species names.

It was noted that the sequence of protecting names had different consequences under the current Codes. In the Botanical Code a specific epithet was validly published only if the name of the genus in which it appeared was valid, whereas this point was treated as irrelevant in zoology.

There are two major approaches to the issue of protected names: a method of what is effectively 'block conservation', or a new starting document which devalidates all unlisted names. The latter approach was accepted by bacteriologists as it avoids arguments as to whether or not an unlisted name should have been included on the list. It is essentially pragmatic, but omitted names can be reinstated, then taking priority only from the date they are revived. This decision needs to be made clearly, but there appears to be no reason why a protected NCU or other officially approved list for a group could not serve as a new starting document.

It was necessary to aim for a practical solution rather than a perfect one, but to incorporate a mechanism to 'fix-it' when something appeared to have gone wrong.

The production of lists, although greatly facilitated by advances in computer technology, is necessarily a laborious task in need of external funding. The current initiatives should be seen as part of an interdisciplinary package working towards a common goal of relevance to the whole of biology. They therefore merit appropriate financial support.

The Meeting encourages international, national, and other agencies to initiate and support current initiatives in compiling lists of names in current use and other catalogues of names, to be made accessible through hard copy and electronic media.

(h) Registration and Valid Publication of Names

In bacteriology new names have to be published in the *International Journal of Systematic Bacteriology* (IJSB). They are permitted to be effectively published elsewhere, but validation is the responsibility of the authors who are required to submit a reprint to the IJSB for inclusion on the validation lists; priority is by a list of running numbers based on the time that manuscripts were received, or even page number within an issue of the IJSB.

The principle of registration as a new mandatory requirement for the valid publication of names was accepted at the XV International Botanical Congress in 1993, subject to ratification at the XVI Congress in 1999, and if so approved will come into effect in 2000. The structure to support the procedure of registration is currently under discussion. The principle is similar in concept to the practice operational in bacteriology, but would not involve publication in a single journal. The critical date was envisaged as that of the submission for registration. A decentralized date-stamping system was being contemplated that could involve national offices working under an agreement with the International Association for Plant Taxonomy (IAPT). The publications and pertinent documentation would then be routed, directly or indirectly, to what are at present indexing centres. The names would then be published in the existing indices (e.g. *Index Kewensis*, *Index of Fungi*), which would be registers for that category of included names (perhaps distinguished typographically). Some orphan groups without indexing centres would have to be covered by IAPT. By 2000, an electronic accessioning and networking system was likely to be in existence.

It was envisaged that: (1) major journal publishers would automatically submit issues of their journals for registration in order not to add to the work of the authors; (2) authors could submit material directly themselves; and (3) persons other than the author could forward material that had not been registered for whatever reason. Authors would be free to send material to any registration office, and not necessarily that in their own country.

In the case of zoology, the *Zoological Record* (published by Biosis International) is the proposed *de facto* registration office for new names, and could be mandated to have this role, but the onus will be on authors and editors to submit material in journals not scanned by the *Zoological Record*. The proposed date for purposes of priority is that of the original publication of the material.

Around 8000 names of taxa in botanical groups appear each year, compared with 10–20 000 in zoological groups and 150–200 in bacteria. Although large overall, the scale was considered to be manageable.

Plant virus names were maintained in the Virus Identification Data Exchange (VIDE) database at CAB INTERNATIONAL, from which hard-copy products were produced (e.g. Brunt *et al.*, 1990), and plans were being formulated by ICTV to produce a universal virus database.

The process of registration for plant cultivar names was started in the 1950s and mainly operates genus by genus, with individual societies or groups of specialists taking responsibility for particular groups. Registration of the name is the responsibility of the person developing the cultivar. The different International Registration Authorities (IRAs) also check that names submitted have not been used previously in that group and that no rules in the Cultivated Plant Code have been contravened. As individual registrars have to interpret the rules, differences in practice can occur. In the orchids, for which the Royal Horticultural Society has IRA responsibility, there are around 3000 applications to register new cultivar names each year. The registration authorities are required to publish periodic lists of registered names. There are many cases with multiple usages of the same name within a genus, the record being about 70 uses of 'Defender' in the genus *Dianthus*. Cultivar names were of crucial importance with respect to names used in plant patents and plant breeders' rights and this posed some difficulties as these have statutory status.

Concern was expressed as to the failure of those concerned with biodiversity and conservation issues to make the link between their indexing procedures and nomenclatural practice. The Meeting considered that there needed to be a far greater awareness of this issue and of the vulnerability of the current indexing authorities to both market conditions and the policies of the disparate organizations operating them. Firm long-term financial mechanisms should be devised in collaboration with appropriate international agencies.

(i) Electronic Publication

The potential of electronic media in connection with the production of compendia of names, and also for the registration of names (see above), was enormous. However, it was unclear how electronic mail access systems in particular might be funded. The costs of indexing and incorporating names into the system should not be forgotten. The involvement of international funding agencies would be essential if a comprehensive system across the whole range of organisms were ever to be realized.

While a readily accessible system was seen as an ideal, some toll-gate or other system would be unavoidable where funds had to be generated to pay for the indexing effort involved, just as is the case for current hard-copy indexing products.

The Botanical and Zoological Codes at present do not consider electronic means as a method of effective publication, but a Special Committee on Electronic Publication was set up at the XV International Botanical Congress in 1993 to consider this question. The time may not yet have come to move away from paper publication, but this would have to be accommodated in due course. However, there was a desire not to encourage the piecemeal publication of unrefereed material of dubious quality by permitting authors to input material directly into databases.

The issue was of considerable relevance to biodiversity inventorying, with the prospect of descriptions of enormous numbers of new species. Mound (*in* Hawksworth & Mound, 1991) calculated that if there were 10 million species of insects, at two pages per species this would require 80 000 volumes and occupy 1.6 km of shelving. Apart from storage, the cost of publishing specialized monographs which have very low sales potential is becoming increasingly difficult.

The problem posed by the magnitude of biodiversity must be faced by the biosystematic community. One option would be a combination of published abstracts linked to an archival electronic database (perhaps copied in 3–5 different centres around the world) so that the fuller data were available when required. CD-ROM storage was another option meriting serious consideration, in that it does appear to be as permanent as paper and is also published at one point in time; moreover, it is not dissimilar from a microfiche in needing a device to be read.

This was a matter which required further exploration and on which all Codes could potentially develop a common policy.

The Meeting notes the rapid advances in electronic media for the storage of and access to taxonomic information, and the opportunities they provide in relation to inventorying the world's currently known and unknown biota, and encourages the IUBS Commission on Taxonomic Databases, in collaboration with the Special Committee on Electronic Publishing and Databasing, to prepare proposals for consideration by the pertinent nomenclatural committees.

(j) Ambiregnal Organisms

Ambiregnal organisms, that is those that have or could be treated under more than one of the current Codes, pose particular nomenclatural problems (Patterson & Larsen, 1991, 1992; Corliss, 1993) and constituted one of the main reasons for the Meeting. Workers in certain protistan groups, such as the dinoflagellates, sooner or later come up against such cases.

Ambiregnal organisms can have more than one 'correct' name, depending upon which Code is applied to them. The problem can apply to the generic name and/or the specific epithet, and to the typification of genera.

For example, the euglenoid generic name *Entosiphon* B. Stein 1878, which has been widely used, is valid under the Zoological Code, but under the Botanical Code it has been replaced by *Entosiphonomonas* Larsen & Patterson 1991 since the angiosperm name *Entosiphon* Beddome 1864 is an earlier homonym.

A more complex and less certain case is that of *Peranema* Dujardin 1841. Dujardin first named his genus *Pyronema* Dujardin in 1836 but then realized this name could be confused with the fungal genus *Pyronema* Carus 1835 published the previous year. Later, *Trachelius trichophorus* Ehrenb. 1838 was combined into *Peranema* as *P. trichophorus* (Ehrenb.) B. Stein 1878, with one of the three original species of Dujardin's genus (*P. protracta* Dujardin 1841) as a synonym; this is one of the best known heterotrophic euglenids used for teaching purposes.

From the botanical standpoint, *Peranema* G. Don 1825 is a genus of ferns so Dujardin's name would be rejected as a later homonym. The organism then has to be called *Pseudoperanema* Christen 1962, based on a different type, if considered as a 'plant', the most appropriate taxonomic placement, but *Peranema* is acceptable if it is treated as an 'animal'. This case is especially awkward as the type in botany is then *Pseudoperanema hyalinum*, whereas in zoology and in *Peranema* it is *P. trichophorum* (syn. *P. protracta*). The generic names and the types thus both differ depending on the taxonomic viewpoint. This case is discussed further by Larsen (1987).

The problems arise for the following reasons:

Independence of the Botanical and Zoological Codes.
Latin diagnoses required in the Botanical Code.
Differences in starting-point dates.
Differences in typification procedures.
Coordination of ranks in the Zoological Code.
Tautonyms not permitted by the Botanical Code.
Basionym citation required by the Botanical Code.
Differences in nomenclatural terms and their meanings.
Homonyms in one Code but not in the other.
Conventional type material is often lacking.
Lack of indication of ambiregnal issues in papers.
Lack of a list of names in current use.
Different ranks used up to at least family.

At present the decisions are essentially those of individual authors and some way of enabling problems to be handled in a consistent manner is required to resolve the current instability and confusion. As up to about 30 000 named species are involved this is not a matter that can be dismissed as of little consequence. The situation has to be resolved.

It would be possible to separate the taxonomic and nomenclatural issues by ruling which Code should be used for which group. In the case of the Botanical Code as revised in 1993, it is explicitly stated that it covers groups traditionally treated under it regardless of the kingdoms to which they are currently taxonomically referred (i.e. including cyanobacteria, fungi, slime moulds, and certain protists). Special provisions for ambiregnal organisms could be included in that Code provided the groups to which they were applied were clearly defined. The removal of an entire group from a Code under which it has traditionally been treated would be particularly destabilizing and should be avoided.

Ambiregnal questions are not unique to protistan groups, and the treatment of names of *Cyanobacteria* is also a cause of uncertainty. The Botanical Code had traditionally handled these organisms, and it was now made clear in it that they are still covered by it. Cyanobacterial names are not included in the *Approved Lists of Bacterial Names*, and a considerable number of cyanobacteria have no living type strains but are represented by dried type specimens. There had been a proposal for a separate Code of Nomenclature for *Cyanobacteria*, but the Meeting felt that this would be most inappropriate in the current climate. In a parallel manner, it would be destabilizing to consider that *Myxomycota* (syn. *Mycetozoa*), as a protistan phylum, should be switched from its traditional treatment under the Botanical Code to the Zoological Code (Weresub, 1979).

The nomenclatural ambiguities posed by ambiregnal organisms could perhaps be resolved by a general decision that the correct name for a protistan (or cyanobacterium, slime mould, etc.) is the oldest name which is valid for it under *any* Code and not a homonym under *another* Code. Each Code could contain an Article to this effect, and the usual safeguards to protect general usage against destabilizing adoption of strict priority would apply.

Alternatively, homonymy might be waived for certain groups, provided that there were no homonyms within the same group; a protist having the same name as a vascular plant or insect was unlikely to cause a problem in practice. The definition of the groups involved would require particular care. The permitting of tautonyms in the Botanical Code from a particular date should also be considered.

A mechanism for collaboration between the nomenclatural committees and commissions concerned with groups with ambiregnal organisms could be helpful to rule on particular cases, but there would also be advantage in having a meeting of specialists on this topic before changes were made in the Codes.

The question of living cultures as types for microbial groups was a long-standing area of difference between the Bacteriological and Botanical Codes. However, some convergence between these two Codes on this issue was now evident. The 1994 edition of the Botanical Code made clear, by means of a voted example, that cultures permanently preserved in a metabolically inactive state (i.e. stored in liquid nitrogen or freeze-dried) were acceptable as nomenclatural types. Conversely, now that DNA could be recovered by polymerase chain reaction (PCR) technology from dried material, bacteriologists could find dried or other uncultured material acceptable. The use of DNA types in botany had already been proposed by two mycologists (Reynolds & Taylor, 1991), but this was not accepted at the XV International Botanical Congress in 1993.

The 'epitype' concept introduced into the Botanical Code in 1993 could be helpful in typifying protist names; in zoology 'neotypes' were sometimes used for what otherwise would be *nomina dubia*, and the term 'pragmatype' had been proposed unofficially in zoology for parallel situations.

> *The Meeting recognizes the particular nomenclatural problems posed by ambiregnal organisms, that is those treated under different Codes, considers that small modifications to the Codes can accommodate these organisms to ensure that the names used will be unique, and recommends that while discussions continue authors should avoid exacerbating the problems.*

(k) Inter-Code Homonyms

The existence of identically spelled generic names correctly in current use for organisms treated under different Codes poses practical problems for information scientists searching databases on key words, and was not now only a matter for the taxonomist. For example, a microbiologist seeking information on the food colouring pigments produced by a species of the fungus genus *Monascus* v. Teighem 1884 would not necessarily wish to have data confused by literature or attributes relating to the trematode parasite of fish belonging to *Monascus* Looss 1907. This can be coped with by 'up-posting', as in the CAB-ABSTRACTS database where each taxon is assigned to a series of higher taxonomic levels, but to utilize such facilities to the full a searcher may need a higher level of training.

While this was not an issue that could be resolved for the names of the past, as it would involve a totally unacceptable number of changes, the problem could be contained from a date in the future. This issue could be resolved even in the absence of any general harmonization of the Codes, as it would be possible to have a parallel provision in all Codes requiring that newly coined generic names must not be homonyms of those existing under any Code. This will be a practical proposition before the turn of the century as by then there will be reasonably complete lists of validly published generic names, or at least those in current use, available in

CD-ROM or other electronic formats (see above). This provision could be considered for inclusion in the next editions of all Codes.

Acceptability to the users of the different Codes would depend very much both on the completeness and quality of the lists, and also their accessibility. It was noted that this could be done with a reasonable degree of confidence at the moment for those with access to the various hard-copy compilations already available.

It was also suggested that there could be difficulties with the enormous numbers of generic names to be coined for the yet undescribed 90% or more of the Earth's biota, if these names were not to become too long. Provision for homonyms to be permitted between specified groups where they were unlikely to be confused taxonomically could be proposed, but this would be complex in practice. For example, a paper dealing with the biology of a plant may also refer to the insects, nematodes, fungi and bacteria occurring on that same plant.

There could also be an advantage if all Codes, other than the Rules for viruses, rendered generic names ending in the suffix '-*virus*' inadmissible, so that this suffix was exclusive to viruses.

The Meeting appreciates the confusion that can be caused by the existence of homonyms in use under the different Codes, and recommends that (a) authors of new generic names avoid proposing a name established under another Code for a different taxon, and (b) provisions are introduced into each Code to disallow new generic names that are junior homonyms under any Code.

(l) Part- and Form-Taxon Nomenclature

Names based on parts or 'traces' of organisms, extant as well as fossil, are considered in various parts of the different Codes. There are problems in common ranging from vertebrate palaeontology to palynology and mycology, and it was agreed that some discussion of these issues should be held. Separated fossil parts, for example, have often been named independently from whole organisms and accommodated in separate hierarchical systems, a so-called 'parataxonomy'. Trace structures (ichnotaxa), for example fossilized footprints, have names, and there were even taxa based on 'works' of animals (such as a bite-hole in a leaf).

In the case of living taxa, some common problems exist, for example in the cases of pleomorphic fungi and algae and animals with complex life-cycles. The interface where taxa cross the fossil/living boundary could also be a cause of difficulties, for example in dinoflagellates. Under the Zoological Code, names compete on a priority basis whether Recent or fossil, or whether based on the whole organism or a part. However, under the Botanical Code, names based on Recent types have precedence over those based on a type which is a fossil.

These problems extend between kingdoms, and although the issues had been the subject of some inter-Code discussions in the 1950s and 1960s they have not been resolved. The problems remain and merit further exploration, and it would be valuable to hold an interdisciplinary meeting to see if there were sufficient common ground to develop a common procedure for palaeoparataxa.

There was some concern as to the use of the word 'parataxon' because of potential confusion with the now much more widely used word 'parataxonomist'. Parataxonomists, often local people, have basic taxonomic training to enable them to collect material for taxonomic study by others as a part of inventory studies (Janzen *et al.*, 1993). A term to be used instead of parataxa could perhaps be debated at the proposed meeting.

Another example, with many parallels, is the future nomenclature of uncultured bacteria and other microorganisms known only from nucleic acid sequences determined directly from environmental samples, and found to be very different from any recorded at present; the ICSB is currently considering this problem.

The Meeting recognizes the need to develop common procedures for the nomenclatural treatment of fossils, with particular emphasis on form genera and other parataxa, and to this end recommends IUBS in cooperation with international and national bodies such as the Systematics Association and Palaeontological Association, to organize a discussion meeting on this topic.

(m) Gender of Epithets

The employment of the rules of Latin grammar means that the termination of adjectival epithets will in the majority of cases change when a species is transferred from one genus to another whose name is of a different gender. This can be confusing as an epithet may not be quickly recognized as a familiar one after transfer, and altered spellings will cause problems in information retrieval. While the principle of Latin grammar is perhaps one of the longest traditions of biological nomenclature, if the purpose of a name is to communicate is there a *scientific* rather than a *linguistic* justification for this practice ? The gender of the name does not convey any biological information about the organism.

This issue merits further consideration by botanists in the light of the suggested provision in the discussion draft for the next Zoological Code that after 1996 generic names will have no gender. The original spellings of epithets would consequently not be changed on transfer from one genus to a new generic assignment (although existing combinations will remain as they are). Epithets such as *alba*, *albus*, and *album* in a genus would be treated as homonyms.

While the abandonment of gender might seem monstrous to one versed in Latin or other European languages with inflections, two-thirds of the world's people do not have a romance language as their native tongue, and even fewer know any Latin. As the names of organisms cater for an international audience the removal of gender considerations could be a major simplification for many users of names.

While it would be possible to indicate gender in compilations of generic names to help taxonomists without linguistic skills, and guidance on gender is available in the recent Zoological Codes and in Stearn (1992), this would not address the question of facilitating retrieval.

If the final version of the Zoological Code includes this change, the matter could perhaps be raised with botanists as a part of a package on harmonization, and the issue merits careful study with respect to any new harmonized biological Code.

4. Future Prospects

(a) Prospects and Principles for a Biological Code

The Meeting had received a challenging document from Dr F.C. Thompson, a member of the ICZN, on the possibilities for a Universal Biological Code. Such a

Code could be envisaged if it were to operate from a starting date in the future; that is, it would initially apply only to new names, and perhaps to certain new nomenclatural acts. It would be based on a registration system, building on existing and projected databases of names so that old names in use could be incorporated in due course.

There had been an attempt to produce a unified Code by Dall (1877), which was arranged in the form of single rules where the Codes were the same, and options as to procedures where they differed; i.e. it essentially combined the then current Codes into a single document and coped with the differences by means of special provisions to maintain current practices. This is paralleled by differences for particular groups such as algae and fungi embodied in the Botanical Code.

It was recognized by the Meeting that some difficulty could be experienced by users if different Codes had to be used for new as opposed to older names, especially as for some groups these extended back to 1753 or 1758. That might at least partly be overcome by having both within a single document.

The Meeting considered that harmonization should be seen not as a luxury but as a necessity. If biological nomenclature is to move towards a truly harmonized Code for the future, rather than to put the past into order through a common system, it would be necessary for biologists to step back from their specialist perspectives and reassess the purposes of Codes.

Agreement would be needed on the form of names, whether to keep a hierarchy, and whether types are to be insisted on as the only way to be sure of what is referred to. Rules such as those relating to priority were viewed as of a lesser order, in being designed to support the basic underlying ideas of the Codes. Some progress in the identification of common principles was made by Savory (1962), but there is now a need to extract the key elements and also to explain the role of the nomenclatural Codes. Points made at the Meeting which need to be embraced in any harmonized Code for the future are summarized in Table 2.

It would also be in the spirit of the IUBS Resolution passed in 1991 (see p. 192) for the existing Codes to start to embrace the issues raised at the Meeting for existing nomenclature as well as procedures to be adopted in the future.

Progress towards such a harmonized Code for the future would not be easy, especially for botanists for whom all changes require the consent of a 60% majority of the members of the Nomenclature Section of an International Botanical Congresses (IBCs), who must therefore be aware of the effects of proposed changes well ahead of the meeting. A harmonized Code is, however, a goal to be strived for in the interests of biology as a whole. One option would be to make a proposal for such a Code to the International Congress of Systematic and Evolutionary Biology (ICSEB) in 1996, ideally with a draft, which could then be considered also by the next IBC in 1999, the ICZN, and other relevant bodies.

The Meeting agrees that it would be highly advantageous to work towards a unified system of biological nomenclature, and notes that the XVI International Botanical Congress in Japan in 1993 established a Special Committee on Harmonizing Codes. The Meeting recognizes that while there are differences in procedures between the current Codes, which could not be reconciled for the nomenclature of the past without an unacceptable disruption of names in use, there is considerable scope for the harmonization which is to be actively pursued.

Table 2. *Points to be considered in the development of a harmonized approach to biological nomenclature.*

1. CODES REGULATE
    - (a) Scientific names of taxa
    - (b) Certain nomenclatural acts
2. CLASSIFICATION DETERMINES NOMENCLATURE
3. SCIENTIFIC NAMES
    - (a) 'Latinized' (i.e. non-vernacular for easy recognition)
    - (b) Fixed hierarchy
    - (c) Species as the basic unit (epithet plus genus name)
    - (d) Standardized endings of higher taxa
    - (e) Labels not descriptors
4. NAMES SHOULD BE
    - (a) Stable (*device*: priority)
    - (b) Unrestricted (*device*: freedom to propose)
    - (c) Necessary (*device*: stating differentiating characters)
    - (d) Unambiguous (*device*: types)
    - (e) Unique (*device*: homonyms disallowed)
5. PUBLICATION
    - (a) In the scientific literature
    - (b) With a description
    - (c) With what they refer to
6. TYPES
    To define what a name refers to (not necessarily 'typical'); i.e. types are 'name-bearers'
7. NAME CHANGES
    To be strictly regulated

(b) Future Liaison and the Role of IUBS

The Meeting noted that there was an international need for a common approach to bionomenclature by regulatory authorities of various kinds, and that these were increasingly crossing traditional boundaries, for example in connection with the Convention on International Trade in Endangered Species (CITES) and 'Red Data Books'.

In order to make progress with the possibilities identified during the present Exploratory Meeting and to provide a mechanism for an on-going dialogue it was regarded as essential to establish an appropriate mechanism. IUBS has a Biotaxonomy and Bionomenclature Committee, but to date this had had a wider remit and not been concerned with nomenclatural issues. Further, this was a matter for IUMS as well as IUBS and an inter-union Commission was therefore required. This could appropriately be called the International Commission on Bionomenclature (ICB) and would benefit from representation of key user organizations.

The first task of the new Commission would be to receive the report of the Exploratory Meeting and where appropriate consider how to implement its findings. There would be an opportunity to report on progress to, and obtain feed-back from, a wider systematic community at the Fifth International Congress of Systematic and Evolutionary Biology (ICSEB V) in Budapest in 1996.

In addition, it was felt that IUBS could promote the inclusion of training in bionomenclature and increase the level of awareness amongst biologists as to its fundamental importance to all aspects of their discipline.

The Meeting recognizes the importance of continuing the dialogue started at, and implementing actions identified by, the Exploratory Meeting, recommends that an inter-union IUBS/IUMS International Commission on Bionomenclature (ICB) be established in 1994, and suggests that the new Commission includes a delegate representing each of the current five Codes, together with representatives from key user bodies (e.g. FAO, UNEP, IUCN, UNESCO, WHO).

The Meeting recommends that the organizers of the Fifth International Congress of Systematic and Evolutionary Biology (ICSEB V), to be held in Budapest in 1996, include a session to review progress towards harmonization and other aspects of bionomenclature.

5. Participants

Mr C.D. Brickell: Chair, International Commission for the Nomenclature of Cultivated Plants; Chair, ISHS Commission for Nomenclature and Registration. (U.K.).

Professor W.G. Chaloner: Past Chair, Committee for Fossil Plants; Editorial and General Committees of Botanical Nomenclature. (U.K.).

Professor J. Dodge: Department of Botany, Royal Holloway College, University of London. (U.K.).

Professor Dr W. Greuter: Rapporteur-général, Botanical Nomenclature; Chair Editorial and General Committees on Botanical Nomenclature; Secretary General, IAPT; IUBS Standing Committee on Biotaxonomy and Nomenclature. (Germany).

Professor D.L. Hawksworth (Meeting Chairman): Chair, International Commission on the Taxonomy of Fungi; General and Editorial Committees of Botanical Nomenclature; Chair, Special Committee on Harmonization between the Codes; IUBS Standing Committee on Biotaxonomy and Nomenclature. (U.K.).

Dr P.M. Kirk: Committee for Fungi. (U.K.).

Professor Dr O. Kraus: President, International Commission on Zoological Nomenclature. (Germany).

Dr J. Larsen: Department of Phycology and Mycology, University of Copenhagen. (Denmark).

Dr A.C. Leslie: International Commission for the Nomenclature of Cultivated Plants, ISHS Commission for Nomenclature and Registration; International Registrar for Cultivar Names, The Royal Horticultural Society. (U.K.).

Dr M.A. Mayo: International Committee on Taxonomy of Viruses; Chair, Plant Viruses Subcommittee. (U.K.).

Professor J. McNeill: Secretary, Editorial Committee of the International Code of Botanical Nomenclature; General Committee on Botanical Nomenclature; Committee for Spermatophyta; IUBS Executive Committee. (Canada).

Dr D.H. Nicolson: President, IAPT; Secretary of General Committee, and member Editorial Committee of the International Code of Botanical Nomenclature. (U.S.A.).

Dr I.W.B. Nye: Secretary-General, International Commission on Zoological Nomenclature. (U.K.).

Dr G. Saddler: International Society for Plant Pathology Subcommittee on Taxonomy of Phytopathogenic Bacteria. (U.K.).

Professor P.H.A. Sneath: Chair, Bergey's Manual Trust; Judicial Commission, International Committee on Systematic Bacteriology. (U.K.).

Professor Dr E. Stackebrandt: Secretary, International Committee on Systematic Bacteriology; Co-editor International Journal of Systematic Bacteriology. (Germany).

Mr R.P. Trehane: Editorial Committee, International Code of Botanical Nomenclature; Compiler Index Hortensis; International Commission on Nomenclature of Cultivated Plants. (U.K.).

Dr P.K. Tubbs: Executive Secretary, International Commission on Zoological Nomenclature; Editorial Committee, International Code of Zoological Nomenclature. (U.K.).

Dr T. Younès: Executive Director, International Union of Biological Sciences. (France).

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Note: In addition to references cited in the text, this Bibliography also includes background papers distributed to participants before the meeting and others tabled or consulted in the course of its deliberations.

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7. Abbreviations and Acronyms

CABI = CAB INTERNATIONAL
CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora
FAO = Food and Agriculture Organization of the United Nations
GC = General Committee on Botanical Nomenclature
IAPT = International Association for Plant Taxonomy
IBC = International Botanical Congress
ICB = International Commission on Bionomenclature
ICNCP = International Commission for the Nomenclature of Cultivated Plants
ICSB = International Committee on Systematic Bacteriology
ICSEB = International Congress of Systematic and Evolutionary Biology
ICTV = International Committee on the Taxonomy of Viruses
ICZN = International Commission on Zoological Nomenclature
IJSB = International Journal of Systematic Bacteriology
IRA = International Registration Authority
ISHS = International Society for Horticultural Science
IUBS = International Union of Biological Sciences
IUCN = IUCN — The World Conservation Union
IUMS = International Union of Microbiological Societies
NCU = Names in Current Use
UNEP = United Nations Environment Programme
UNESCO = United Nations Educational, Scientific and Cultural Organization
VIDE = Virus Identification Data Exchange
WHO = World Health Organization